What is claimed is:

1. A diffractive optical element comprising:

a first optical region made of a first optical material which is substantially transparent to light within a wavelength range to be used;

a second optical region made of a second optical material which is substantially transparent to said light but is different from said first optical material;

a third optical region made of a third optical material which is transparent to said light but is different from said second optical material, said first, second and third optical regions being arranged to be brought into contact with each other or being arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a first depth; and

a second relief pattern formed in a boundary surface between said second and third optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth which is different from said first depth of the first relief pattern, said first and second relief patterns being substantially aligned in a direction of an optical axis of the diffractive optical element.

2. A diffractive optical element comprising:

a first optical region made of a first optical material which reflects light within a wavelength range to be used;

a second optical region made of a second optical material which is substantially transparent to said light;

a third optical region made of a third optical material which is substantially transparent to said light but is different from said second optical material, said first, second and third optical regions being arranged to be brought into contact with each other or being arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a first depth; and

a second relief pattern formed in a boundary surface between said second and third optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth which is different from said first depth of the first relief pattern, said first and second relief patterns being substantially aligned in a direction of an optical axis of the diffractive optical element.

3. A diffractive optical element comprising:

a first optical region made of a first optical material which is substantially transparent to light within a wavelength range to be used and has a refractive index $n_1$;

a second optical region made of a second optical material which is substantially transparent to said light but is different from said first optical material and has a refractive index $n_2$;

a third optical region made of a third optical material which is transparent to said light but is different from said second optical material and has a refractive index $n_3$, said first, second and third optical regions being arranged to be brought into contact with each other or being arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a depth $d_1$; and

a second relief pattern formed in a boundary surface between said second and third optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth $d_2$, said first and second relief patterns being substantially aligned in a direction of an optical axis of the diffractive

optical element, wherein when a ratio of the depth of the second relief pattern to the depth of the second relief pattern is $\alpha(=d_2/d_1)$, a wavelength of the light within the wavelength range to be used is $\lambda$, a shortest wavelength of the wavelength region to be used is $\lambda_1$, and a longest wavelength of the wavelength range to be used is $\lambda_2$, the following condition is satisfied:

$$|\Delta N(\lambda_2)| > |\Delta N(\lambda_1)| > 0 ; \lambda_2 > \lambda_1$$

wherein

$$\Delta N(\lambda) = \{n_1(\lambda)-n_2(\lambda)\} + \alpha\{n_2(\lambda) - n_3(\lambda)\}$$

4. A diffractive optical element according to claim 1, 2 or 3, wherein a ratio of the depth of the second relief pattern to the depth of the second relief pattern $\alpha(=d_2/d_1)$ is set such that a phase shift function of the first relief pattern and a phase shift function of the second relief pattern are canceled out each other.

5. A diffractive optical element according to claim 1, 2 or 3, wherein said third optical region is constituted by an atmosphere surrounding the diffractive optical element.

6. A diffractive optical element according to claim 1, 2 or 3, wherein when an average refractive index of a composite relief structure constituted by the first and second relief patterns is $n_0$), a thickness of the diffractive optical element is D, and a smallest pitch

of the relief patterns is T, the following condition is satisfied:

$$\frac{2\pi\lambda D}{n_0 T^2} < 1$$

7. A diffractive optical element according to claim 1, 2 or 3, wherein when a shortest wavelength of the wavelength range to be used is $\lambda_1$, a longest wavelength of the wavelength range to be used is $\lambda_2$, and a middle wavelength between $\lambda_1$ and $\lambda_2$ is $\lambda_0$ ($=(\lambda_1 + \lambda_2)/2$), the following condition is satisfied:

$$\lambda_2 - \lambda_1 > 0.05\lambda_0$$

8. A diffractive optical element comprising:

a first optical region made of a first optical material which is substantially transparent to light within a wavelength range to be used;

a second optical region made of a second optical material which is substantially transparent to said light but is different from said first optical material;

a third optical region made of a third optical material which is substantially transparent to said light;

a fourth optical region made of a fourth optical material which is transparent to said light but is different from said third optical material, said first, second, third and fourth optical regions being arranged to be brought into contact with each other or being

arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a first depth; and

a second relief pattern formed in a boundary surface between said third and fourth optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth which is different from said first depth of the first relief pattern, said first and second relief patterns being aligned in a direction of an optical axis of the diffractive optical element.

9. A diffractive optical element comprising:

a first optical region made of a first optical material which reflects light within a wavelength range to be used;

a second optical region made of a second optical material which is substantially transparent to said light;

a third optical region made of a third optical material which is substantially transparent to said light;

a fourth optical region made of a fourth optical material which is substantially transparent to said light but is different from said third optical material,

said first, second, third and fourth optical regions being arranged to be brought into contact with each other or being arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a first depth; and

a second relief pattern formed in a boundary surface between said third and fourth optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth which is different from said first depth of the first relief pattern, said first and second relief patterns being substantially aligned in a direction of an optical axis of the diffractive optical element.

10. A diffractive optical element comprising:

a first optical region made of a first optical material which is substantially transparent to light within a wavelength range to be used and has a refractive index $n_1$;

a second optical region made of a second optical material which is substantially transparent to said light but is different from said first optical material and has a refractive index $n_2$;

a third optical region made of a third optical material which is substantially transparent to said

light and has a refractive index $n_3$;

a fourth optical region made of a fourth optical material which is transparent to said light but is different from said third optical material and has a refractive index $n_4$, said first, second, third and fourth optical regions being arranged to be brought into contact with each other or being arranged close to each other;

a first relief pattern formed in a boundary surface between said first and second optical regions and having a first pitch distribution and a first depth $d_1$; and

a second relief pattern formed in a boundary surface between said third and fourth optical regions and having a second pitch distribution which is substantially identical with said first pitch distribution of the first relief pattern and a second depth $d_2$, said first and second relief patterns being substantially aligned in a direction of an optical axis of the diffractive optical element; wherein a ratio of the first depth to the ~~depth of the~~ second depth is $\alpha(=d_2/d_1)$, a wavelength of the light to be used is $\lambda$, a shortest wavelength of a wavelength region of the light to be used is $\lambda_1$, and a longest wavelength is $\lambda_2$, the following condition is satisfied:

$$|\Delta N(\lambda_2)| > |\Delta N(\lambda_1)| > 0 \; ; \; \lambda_2 > \lambda_1$$

wherein

$$\Delta N(\lambda) = \{n_1(\lambda)-n_2(\lambda)\} + \alpha\{n_3(\lambda)-n_4(\lambda)\}$$

11. A diffractive optical element according to claim 8, ~~9 or 10~~ wherein a ratio of the depth of the second relief pattern to the depth of the ~~second~~ first relief pattern $\alpha(=d_2/d_1)$ is set such that a phase shift function of the first relief pattern and a phase shift function of the second relief pattern are canceled out by each other.

12. A diffractive optical element according to claim 8, ~~9 or 10~~ wherein said second and third optical regions are made of a same optical material.

13. A diffractive optical element according to claim 8, ~~9 or 10~~ wherein said fourth optical region is constituted by an atmosphere surrounding the diffractive optical element.

14. A diffractive optical element according to claim 8, ~~9 or 10~~ wherein when an average refractive index of a composite relief structure constituted by the first and second relief patterns is $n_0$, a thickness of the diffractive optical element is D, and a smallest pitch of the relief patterns is T, the following condition is satisfied:

$$\frac{2\pi\lambda D}{n_0 T^2} < 1$$

15. A diffractive optical element according to claim 8, ~~9 or 10~~ wherein when a shortest wavelength of the

wavelength range to be used is $\lambda_1$, a longest wavelength of the wavelength range to be used is $\lambda_2$, and a middle wavelength between $\lambda_1$ and $\lambda_2$ is $\lambda_0$ ($=(\lambda_1 + \lambda_2)/2$), the following condition is satisfied:

$$\lambda_2 - \lambda_1 > 0.05\lambda_0$$

~~16. An optical device comprising a diffractive optical element according to any one of claims 1-15.~~

D1

A

Add A3

add B4

add C4